

7 a shielding means carried on the pump housing, the
8 shielding means having an internal shaft-receiving opening;
9 a power device adapted to be supported above the bath of
10 molten metal, and to be actuated in a powered motion;
11 means for connecting the power device to the pumping
12 member to move the pumping member in said path of motion, comprising;
13 a pumping shaft having an upper end connected to the
14 power device so as to be moved when the power device is actuated, and a lower
15 driving end connected to the pumping member to drive the pumping member in said
16 path of motion when the power device is actuated;
17 [the driving end of] the shaft having a first coefficient of thermal expansion and the [socket] shielding means having a different coefficient of
18 thermal expansion; and
19
20 the shaft [means] being telescopically disposed in the [shielded]
21 shielding means out of contact with the molten metal, and forming a chamber between
22 the shaft and the shielding means sufficient to permit thermal expansion of the shaft
23 without imposing a radial thermal stress on the shielding means.

1 11. (Amended) Apparatus as defined in claim 7, in which the tubular shield
2 means includes:
3 an outer tubular shield having a lower end attached to the pump
4 housing;

an inner tubular shield telescopically disposed in said outer tubular shield and being attached thereto;

the inner tubular shield having a bore with a diameter greater than the diameter of the shaft, and enclosing the shaft so as to form a chamber therearound;

the lower end of the inner tubular shield being spaced from the lower end of the outer tubular [member] shield to form a driving chamber;

a driving structure supported on the lower end of the shaft enclosed within the outer shield; and

cement disposed in the outer shield having a socket accommodating the configuration of said driving structure, the driving structure being disposed in said socket but having a clearance therebetween to accommodate the relative thermal expansion characteristics of said driving structure and the socket, but permitting the driving structure to be rotated to engage the socket [wall] in the cement to rotate the pumping member.

16. (Amended) A combination, comprising:

pot means for containing a bath of molten metal;

a pumping member adapted to be disposed in a bath of a heated molten metal, and to move a stream of molten metal as the pumping member is driven in a path of motion;

a housing at least partially enclosing the pumping member;

7 a shielding means carried on the pump housing, the shielding
8 means having an internal shaft-receiving opening;
9 a power device adapted to be supported above the bath of molten
10 metal, and to be actuated in a powered motion;
11 means for connecting the power device to the pumping member to
12 move the pumping member in said path of motion, comprising;
13 a pumping shaft having an upper end connected to the power
14 device so as to be moved when the power device is actuated, and a lower driving end
15 connected to the pumping member to drive the pumping member in said path of motion
16 when the power device is actuated;
17 the driving end of the shaft having a first coefficient of thermal
18 expansion and the [socket] shielding means having a different coefficient of thermal
19 expansion; and
20 the shaft [means] being disposed in the shielding means out of
21 contact with the molten metal, and forming a chamber between the shaft and the
22 shielding means sufficient to permit thermal expansion of the shaft without imposing a
23 radial thermal stress on the shielding means.

Please cancel claim 17.

In claim 18, line 12, after "a", first occurrence, insert --- tubular ---

line 14, after "shaft" insert --- ; ---

line 16, after "and", first occurrence, insert --- the ---

line 16, after "shield" insert --- means ---.

1 25. (Amended) Apparatus as defined in claim 18¹², including a pump housing at
2 least partially enclosing the pumping member, and in which the tubular shield means
3 includes an outer tubular shield having a lower end attached to the pump ^{member} housing; and
4 an inner shield telescopically disposed in said outer tubular
5 [element] shield and being cemented thereto, [the shaft being connected to the inner
6 shield].

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1 26. (Amended) Apparatus as defined in claim 18, including a pump housing at
2 least partially enclosing the pumping member, and in which the shield means includes:
3 an outer tubular shield having a lower end attached to the pump
4 housing,
5 an inner tubular shield telescopically disposed in said outer tubular
6 shield and being cemented thereto;
7 the inner tubular shield having a bore with a diameter greater than
8 the diameter of the pumping shaft, and enclosing the pumping shaft so as to form a
9 chamber therearound;
10 the lower end of the inner tubular [member] shield being spaced
11 from the lower end of the outer tubular [member] shield to form a shoulder;
12 a structure disposed adjacent the lower end of the drive shaft
13 having a diameter greater than the diameter of the bore of the inner tubular shield but

14 less than the diameter of the outer shield [to form a shoulder], and the structure
15 engages the shoulder to locate the lower end of the shaft with respect to the [tubular]
16 shield means; and
17 cement disposed in the lower end of the outer tubular shield with a
18 socket accommodating the configuration of [the lower end of the shaft] said structure
19 but having a clearance therebetween to accommodate the relative thermal expansion
20 characteristics of said [driving end to be rotated into] structure and the cement in the
21 socket [to rotate the pumping member].

1 ²⁴ 27. (Amended) Apparatus as defined in claim ²⁵ 26, in which [the lower end of the
2 shaft] said structure has a tongue-shaped configuration.

1 ²⁸ 28. (Amended) Apparatus as defined in claim ²⁵ 26, in which [a] the clearance
2 between the lower end of the shaft and the socket is formed by the steps of:
3 forming the outer tubular shield with a lower blind end;
4 disposing a cement in the blind end of the outer tubular [member]
5 shield to form a socket having the configuration similar to but larger than that of [a
6 driving end] said structure;
7 disposing wax that turns to gas when exposed to [a] the heat in the
8 bath of molten metal in said socket;
9 disposing [the lower driving end of the shaft] said structure in the
10 wax;

11 inserting the inner tubular member into the outer tubular [member]
12 shield so as to engage [the driving end of the pumping shaft] said structure, and
13 cementing the inner tubular [member] shield to the outer tubular
14 [member] shield to form a unitary tubular shield around the shaft.

In claim 29, line 5, after "a" insert --- ceramic ---.

In claim 30, line 17, after "bottom" insert --- inlet ---.

In claim 31, line 15, change "vane", first occurrence, to --- vanes ---.

In claim 32, line 9, change "a" to --- the ---.

In claim 34, line 2, change "slinger" to --- strainer ---.

In claim 40, line 5, change "engageable" to --- engaged ---.

Please insert the following new claims:

1 46. An apparatus for moving a stream of molten metal comprising:
2 a pumping member;
3 a housing at least partially enclosing the pumping member;
4 a power device; and
5 a shaft connecting the power device and the pumping member,
6 said shaft having an elongated drive element and an elongated shield assembly, the
7 shield assembly surrounding, and forming a space between the drive element and the
8 shield assembly sufficient to permit thermal expansion of the drive element.

1 ³⁵
⁴⁷ The apparatus of claim ³⁴~~46~~, wherein said drive element is comprised of
2 steel.

1 ³⁴
⁴⁸ The apparatus of claim ³⁴~~46~~, wherein said shield assembly is at least
2 partially comprised of ceramic.

1 ³⁷
⁴⁹ The apparatus of claim ³⁴~~46~~, wherein the pumping member is an impeller.

1 ³⁸
⁵⁰ The apparatus of claim ³⁴~~46~~, wherein the shield assembly further comprises
2 inner and outer telescoping shield members.

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1 ³⁹
⁵¹ The apparatus of claim ³⁸~~50~~, in which a substantial length of an inner
2 diameter of the inner shield is greater than an outer diameter of an overlapped portion
3 of said drive element.

1 ⁴⁰
⁵² The apparatus of claim ³⁸~~50~~, wherein the drive element includes a shoulder
2 adjacent a pumping member end, and the inner shield members abuts said shoulder.

1 ²⁹
⁵³ The apparatus as defined in claim ^{72 28}~~52~~, wherein said drive element
2 includes an extension below said shoulder.

1 ³⁰
⁵⁴ 54. The apparatus as defined in claim ²⁹
₁ 53, wherein a castable compound
2 secures said extension to the outer shield member.

1 ⁵⁵
³⁰ 55. The apparatus as defined in claim 46, in which the shield assembly
2 comprises:
3 an outer tubular shield having a lower end adjacent the housing,
4 an inner tubular shield telescopically disposed in said outer tubular
5 shield and attached thereto;
6 the inner tubular shield having a bore with a diameter greater than
7 the diameter of the drive element, and enclosing the drive element to form a chamber
8 therearound;
9 a tongue extending from said drive element outside of said inner
10 tubular shield;
11 one or both of said inner tubular shield or said tongue being
12 secured to said outer shield, and
13 said outer shield being secured to said pumping member.

1 ³¹
⁵⁶ 56. The apparatus of claim ²⁸
₁ 55, wherein an intermediate connecting unit mates
2 said outer shield to said pumping member.

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1 ⁴²
 ⁵⁷ The apparatus as defined in claim ³⁴~~46~~, in which the shield assembly
2 comprises:

3 an outer tubular shield;

4 an inner tubular shield telescopically disposed in the outer shield;

5 said inner tubular shield surrounding said drive element;

6 an elongated graphite member disposed between said inner and
7 outer shields;

8 a connector formed on the lower end of the graphite member and
9 secured to the pumping member; and

10 cement disposed in the outer shield to provide a socket
11 accommodating a portion of said drive element extending out of said inner tubular
12 shield, the drive element being disposed in said socket but having a clearance
13 therebetween to accommodate the relative thermal expansion characteristics of said
14 drive element, but permitting the driving element to be rotated to engage the socket to
15 rotate the pumping member.

1 ⁴³
 ⁵⁸ The apparatus as defined in claim ⁴²~~57~~, in which the drive element includes
2 a tongue-shaped extension.

1 ⁴⁴
 ⁵⁹ The apparatus as defined in claim ⁴³~~58~~, in which the tongue-shaped
2 extension is integrally formed with the lower end of the drive element.

1 ⁴⁵
 ⁶⁰ The apparatus as defined in claim ⁴³~~58~~, in which the tongue-shaped
2 extension is integrally formed with the lower end of the shaft.

1 ⁴⁶
 ⁶¹ The apparatus as defined in claim ⁴¹~~55~~, in which a clearance is provided
2 between the tongue and the outer shield by the steps of:

3 forming the outer tubular shield with a lower blind end;

4 disposing a cement in the blind end of the outer tubular shield to
5 form a socket having the configuration similar to but larger than that of the drive
6 element;

7 disposing a wax that turns to gas when exposed to the heat in a
8 bath of molten metal, in said socket;

9 positioning the drive element in the wax, and

10 telescopically inserting the inner tubular shield in the outer tubular
11 shield to engage the drive element, and cementing the inner tubular shield to the outer
12 tubular shield to form a unitary shield around the shaft.

1 ⁴⁷
 ⁶² The apparatus of claim ³⁴~~46~~, further including at least one post supporting
2 said power device above said housing,

3 said post including an annular groove;

4 said housing including a socket having a cooperative annular
5 groove; and

6 a retaining element positioned in said grooves.

1 ⁴⁸
 ⁶³ The apparatus of claim ³⁴~~46~~, including:
2 a post supporting said power device above said housing;
3 said post having a leg portion and a shield portion of heat resistant
4 material surrounding said leg; and
5 and an inner diameter of said shield portion being greater than the
6 outer diameter of said leg.

1 ³³
 ⁶⁴ The assembly of claim ³⁴~~63~~, further comprising a bore in said leg for
2 introduction of an inert gas.

1 ⁴⁹
 ⁶⁵ The assembly of claim ³⁴~~46~~, wherein said pumping member includes vanes
2 for moving molten metal, the vanes creating passages therebetween, a strainer means
3 provided on an inlet opening, said strainer means having openings of a diameter
4 narrower than the vane passages.

1 66. An elongated support suited for positioning in a bath of molten metal,
2 comprising:
3 a housing of a material that is resistant to the heat of the molten
4 metal, said housing having an internal chamber;
5 means for introducing an inert gas into said internal chamber;
6 structure disposed in the internal chamber; and